EXPLORATORY TUNA FISHING IN INDONESIAN WATERS

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EXPLANATORY NOTE

The series embodies results of investigations, usually of restricted scope, intended to aid or direct management or utilization practices and as guides for administrative or legislative action. It is issued in limited quantities for the official use of Federal, State or cooperating agencies and in processed form for economy and to avoid delay in publication.

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United States Department of the Interior
Oscar L. Chapman, Secretary
Fish and Wildlife Service
Albert M. Day, Director

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Pacific Oceanic Fishery Investigations

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2/ South Sea Fisheries [Nanyō Suisan], No. 80, (Vol. 8), No. 1. January 25, 1942. pp. 29-41.

A Survey of Tuna Grounds in Equatorial Waters

1. Purpose.

Good results were obtained from the previous survey of tuna fishing grounds in the waters south of Palau, however, further attention must be paid to the equatorial waters, which are considered as a continuation of these fishing grounds, since they have been fished recently by tuna fishing vessels from Japan and since they must be considered as future fishing grounds. For this reason, an extensive area was surveyed to determine whether or not it has any value as a fishing ground. The findings are submitted herein as reference data for the planning of commercial operations. (Note) The first fishing test was planned in accordance with the northward shift of the Equatorial Counter-current at this season.

2. Particulars of the survey.

a. Survey period-May 9 to May 24, 1941-16 days

b. Area surveyed-From 6° N latitude to 1° S latitude and from 129° to 134° E longitude

c. Survey ship. Zuiho Maru, 133 tons, 360 HP

d. Fishing gear used in the survey-Tuna longlines (50 baskets, 6 hooks per basket).

Brief description of one basket of tuna longline fishing gear. Main line-cotton line 10-strand, 45 gr per [5-foot] fathom; total length 175 fathoms (length of one section is 25 fathoms).
Branch lines-10-strand cotton line, 37.5 gr per fathom, length 12.5 faihoms. 6 pieces
Float lines-10-strand cotton line, 45 gr per fathom, length 12.5 fathoms. 1 piece
Cotton-covered wire-3 strands of 3 wires each, (eyes [?] both ends), length 4 fathoms, 6 pieces
Wire leader-length 1.5 fathoms, 6 pieces

3. Results

(1) Result of each operation.

First fishing test, May 10

This fishing ground is located about 100 miles south of Palau (5°40'N, 134°31'E) and due to the seasonal northward shift of the Equatorial Counter-current, is believed to be in the Counter-current area. Details of the current, however, were not known.

Lines were set in a southwesterly direction from 50 baskets. Since the catch amounted to only 3 yellowfin and 1 big-eyed tuna, it was believed to be too early for the fishing season.

Second fishing test, May 12

This fishing ground is located about 300 miles south of the first fishing ground at 0°35' N latitude and 134°26' E longitude near the Equator. Lines from 50 baskets were set in a southerly direction. The current flowed W½N at 1.6 knots. The water temperatures of 29.6 degrees at the surface, 28.6 degrees at the 50-meter layer and 24.8 degrees at the 100-meter layer were satisfactory.

Since we were close to the [illegible] Islands, young tunas were seen. The catch consisted of 1 yellowfin (shark-eaten) and 1 spearfish.

Third fishing test May 13

This fishing ground is located at the Equator at 0°35' N latitude and 134°26' E longitude. Of the fishing grounds surveyed, this ground showed the best results (catch ratio of 14.0%, /i.e. 14.0 fish per 100 hooks fished/). Lines from 50 baskets were set in a southerly direction. The current flowing W / N 3/4 N at 1.5 knots was roughly the same as that of the second fishing station and clearly indicated that this ground lies within the Southern Equatorial Current. The water temperatures were 30.5 degrees at the surface, 28.5 degrees at the 50-meter layer and 25.0 degrees at the 100-meter layer. The catch consisted of 37 yellowfin (5 shark-eaten) and 1 skipjack. The fish in general were small in size.

Fourth fishing test May 14

This ground is located at 0°11' N latitude and 131°41' E longitude in the equatorial waters west of the third fishing ground. Lines from 50 baskets were set in a southeasterly direction. The current velocity was W / N at 1.3 knots (in the Southern Equatorial current). The water temperatures were 29.7 degrees at the surface, 26.5 degrees at the 50-meter layer, and [illegible] degrees at the 100-meter layer. The catch consisted of 25 [illegible] and 2 sailfish.

Fifth fishing test May 15

This fishing ground is located about 1 degree north of the Equator at 1°11' N latitude and 131° 50' E longitude. Lines from 50 baskets were set in a westerly direction. The current flow was NW at 2.0 knots. The water temperatures were 29.3 degrees at the surface, 26.7 degrees at the 50-meter layer, and [illegible] degrees at the 100-meter layer. About one-half of the [illegible] consisted of young tuna (15 large yellowfin and 12 young yellowfin) which weighed from 2 to 3 kan /1 kan = 8.27 lbs./. From two of the [illegible] seen in the area this school is believed to have been associated with birds and driftwood.

Sixth fishing test, May 17

For the first time we entered the southern latitudes. This ground was located 14' south of the Equator at 0°14' S latitude and 129°25' E longitude. Lines from 50 baskets were set out to the NNW. This ground was located between the northwest shores of New Guinea and Halmahera Island. Many small islands are found in the area and the flow of tidal currents is very complex. Numerous sharks infest the area and about one half of the catch was shark-bitten. (The catch comprised 14 yellowfin, 13 of them shark-bitten, and 7 sharks.) The fish were generally large. The water temperatures were 29.5 degrees at the surface, 28.8 degrees at the 50-meter layer, and 23.0 degrees at the 100-meter layer.

Seventh fishing test May 18

This fishing ground is located about 30 miles south of the sixth ground at 0°44' S latitude and 129°24' E longitude. Since the fish hold was full, only 30 baskets were used. Lines were set in a southerly direction. The flow of the current was similar to that of the sixth fishing ground. The catch consisted of 5 yellowfin and 1 sailfish.

(2) Investigation of the vertical distribution of the tuna (yellowfin) (Note) Float lines 12.5 fathoms long and branch lines 12.5 fathoms long (also cotton-covered wire 4 fathoms long and wire leaders 1.5 fathoms long) were used.

(3) Handling of the catch.

After capture, the viscera were removed and the fish were washed. The washed fish were immediately wrapped in paper, covered with crushed ice, and stored in a refrigerator. Due to mechanical trouble, the refrigerator could not be operated during this trip. Although sufficient care was taken in doing, the fish deteriorated to a certain extent due to the length of time which elapsed before returning to Palau.

(4) The peculiar phenomena of the catch ratio and water temperature (at the 100-meter layer)

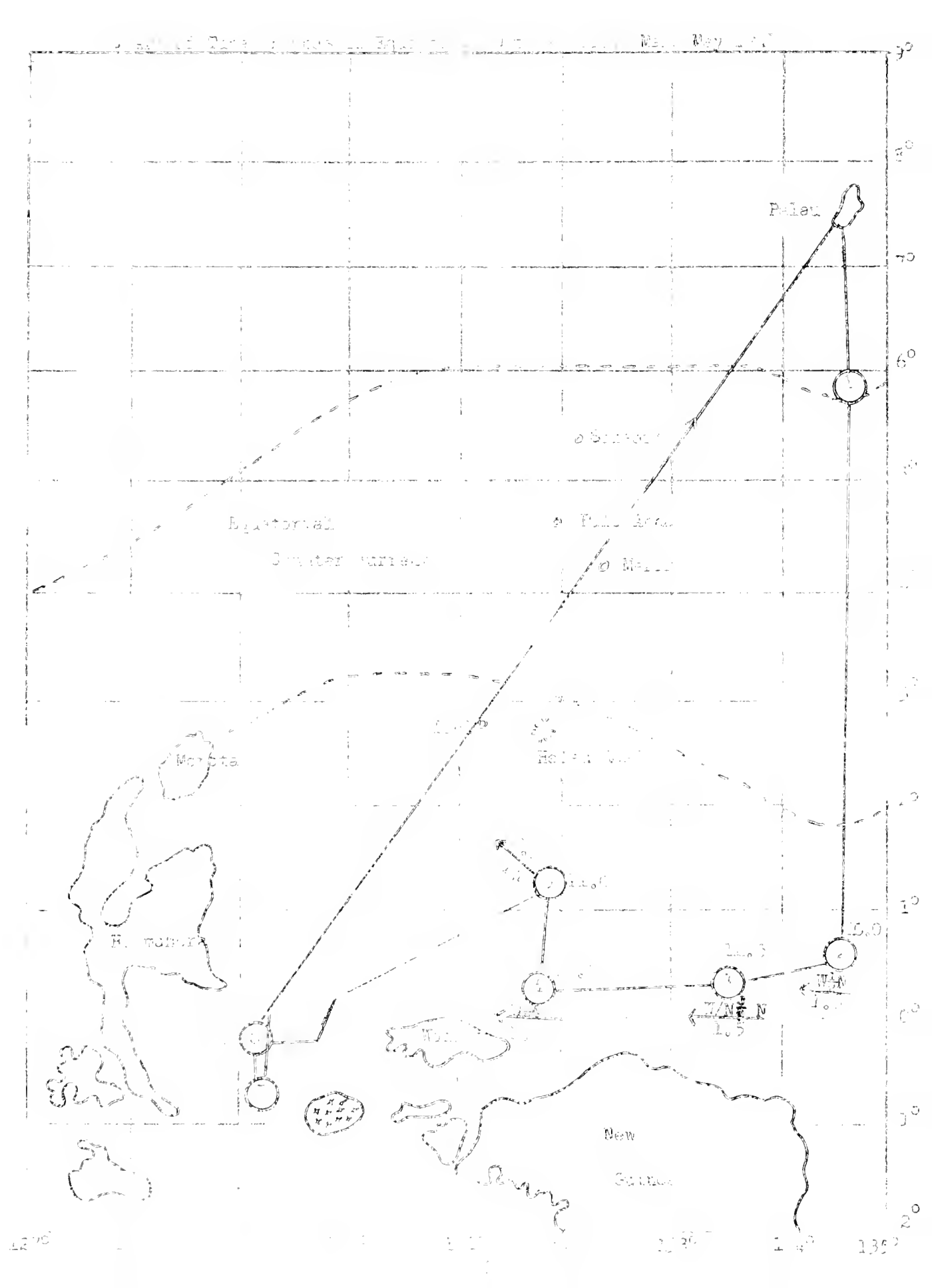
The catch ratios ranged from a minimum of 1.0 to a maximum of 14.0.

The second, third, fourth, and fifth fishing grounds showed catch ratios of 10.0 and over. An interesting phenomenon is presented when these catch ratios are considered in connection with the water temperatures of the 100-meter layer.

FISHING GROUND	CATCH RATIO	WATER TEMPERATURE AT 100-METER LAYER
1	1.0	22.6°
2	10.0	24.8°
3	14.0	25.0°
4	10.0	24.8°
5	11.0	24.8°
6	9.0	23.0°
7	2.0	22.0°

As seen in the above tables, fishing grounds having catch ratios of 10.0 or more, all showed water temperatures higher than 24 degrees at the 100-meter layer. We can deduce therefore, that yellowfin prefer a water temperature of over 24.0 degrees to that of less than 24.0 degrees.

FISHING GROUND	DATE	POSITION	BASKETS USED	HOOKS USED	CATCH BY HOOK NUMBERS						CATCH RATIO (INCLUDING FISH EATEN BY SHARKS)
					1	2	3	4	5	6	
1	10 May	5°40'N 134°41'E	50	300		1	1			1	1.0
2	12 May	0°35'N 134°26'E	50	300	3	6	-	8	4	2	10.0
3	13 May	0°18'N 133°27'E	50	300	4	10	9	8	8	3	14.0
4	14 May	0°12'N 131°44'E	50	300	4	4	5	5	6	6	10.0
5	15 May	1°11'N 131°50'E	50	300	2	3	9	8	8	5	11.0
6	17 May	0°14'S 129°2.5'E	50	300	3	4	5	3	8	4	9.0
7	18 May	0°44.5'S 129° 8.5'E	30	180		3	2		1		2.0
TOTALS					16	32	38	32	35	21	


Palau
Equatorial
Mortlock
Nukuoro
New

Report of Tuna Investigations by the Wakayama Prefecture Research Vessel, Kiyō Maru, in the Timor, Arafura, and Banda Seas

1. Introduction

With the recent grant of subsidy funds from the Colonial Office to the Nankō Fishing Company for the purpose of investigating the fisheries of the Outer South Seas area, the Company employed the Wakayama Prefecture research vessel, Kiyō Maru, to carry out a survey in the Timor, Arafura, and Banda seas, areas which are under foreign domination. I was aboard the vessel during that investigation and will publish herewith the information which was contained in the report submitted to the Colonial Office.

2. Outline of the Investigation

Period of the survey - From June 29, 1941, to July 25, 1941 - 27 days
Area surveyed - Timor Sea, Arafura Sea, Banda Sea
Surveying vessel - Kiyō Maru, research vessel of Wakayama Prefecture, a steel vessel of 127.23 gross tons and 220 horsepower.
Personnel of the survey - Technician Saburō Kawabe, the captain of the Kiyō Maru and 24 men
Fishing gear used in the survey - tuna longlines, 230 baskets
Construction of one basket of gear - trunk line of cotton, 8 momme to the fathom, [1 momme = .132 oz.] 189 fathoms overall length (7 pieces joined, each piece 29 fathoms long).
Branch lines of cotton, 9 momme to the fathom, 2 lines 10 fathoms long, 2 lines 7 fathoms long, 2 lines 6 fathoms long. Sekiyama of 3x3 strands of wire with eyes in both ends, 4 fathoms long.
Wire leader, 2 fathoms long.
Hooks, 4.86 inches and 3.2 inches long.
Float lines, cotton, 8 momme to the fathom, 15 fathoms long.
However, about half of the float lines and trunk lines were made of Manila hemp. [TN: The "fathoms" mentioned above are Japanese fathoms, about 5 feet long. Hook sizes are the total length from eye to point around the curve of the hook. The

Also on the [illegible] Fishing Ground	Sakurai, Daikichi
Captain	Tauchii, Tetsuhiko
Chief Engineer	Imamoto, Sōmon
Engineer	Kasajima, Chūji
Fishing Captain	Kogura, Otomatsu
Wireless Operator	Shima, Hidetarō
"	Higashi, Saishachi
"	Itomi, Fusao
"	Matsuhira, Yūichirō
"	Yamamoto, Iwarō
"	Ido, Isao
"	Okachi, Shōichirō
"	Tsuchi, Hikotaro
"	Tanimoto, Tadao
"	Iwami, Yūichi
"	Yokoyama, Chūichi
"	Hirata, Kanpei
Cook	Matsushima, Sadami
"	Matsubara, Eiichi
"	Ishida, Kazuo
"	[illegible]
"	Matsuura, Kazuo
"	Matsuura, Sukeichi

C. Progress of the Kyoshin Maru

(1) [illegible] and sailing [illegible]

July 20 - 0900 - Departed Palau.

[illegible]

July 2 - 1100 - [illegible]

[illegible]

July [illegible] - [illegible] (4 [illegible], 1 [illegible], 1 [illegible] [illegible] book)

[illegible]

July 7 - [illegible] at Dilli.

July 8 - 0900 - Departed Dilli.

July 9 - Finished second station off [illegible] Timor, set 200 [illegible] etc.

[illegible]

July 11 - [illegible] off south side of [illegible] I., set 12[illegible] [illegible]. ([illegible] yellowfin, 2 big-eyed, 1 albacore, 1 [illegible], [illegible] fish bitten by sharks and killer whales).

July 12 - Fished fourth station west of Tanimbar I., set 120 baskets. (8[illegible] yellowfin, 1 true marlin, 1 sailfish, 1 big-eyed, 13 fish shark-bitten, 1 shark)

July 13 - Fished fifth station at same position, set 155 baskets. ([illegible]2 yellowfin, 1 big-eyed, 1 black marlin, 1 true marlin, [illegible] sharks, 10 fish shark-bitten)

July 15 - Fished sixth station west of Kei I., set 100 baskets. ([illegible] yellowfin, 2 big-eyed, 6 sharks, 1[illegible] shark-bitten fish)

July 16 - Fished seventh station at same position, set 100 baskets. (4[illegible] yellowfin, 3 big-eyed, 2 white marlin, 8 fish shark-bitten)

July 17 - Fished eighth station east of Banda I., set 120 baskets. (48 yellowfin, 11 big-eyed, 9 sharks, 11 fish shark-bitten)

July 1[illegible] - [illegible] 1[illegible]0 baskets. ([illegible] yellowfin, [illegible] big-eyed, [illegible] sharks, [illegible] fish shark-bitten)

July 1[illegible] - Fished [illegible] of [illegible] I., set 20 baskets. ([illegible] yellowfin, [illegible] sharks, 2 fish shark-bitten)

July 2[illegible] - 1[illegible] - [illegible]

July 21 - [illegible] - Passed through [illegible] Strait

July 22 - [illegible] 1° 51' N, 1[illegible]° 10' E.

July 23 - [illegible] 4° [illegible] N, 1[illegible]° [illegible] E.

July 2[illegible] - [illegible] - [illegible] I.

July 2[illegible] - [illegible] - [illegible]

[illegible]

[illegible]

[illegible] until [illegible] theast with [illegible] the following day, the 20th, [illegible] until [illegible] 1[illegible]00, when the vessel passed [illegible] I., [illegible] Passage on July [illegible] the wind [illegible] from [illegible] and the [illegible] were [illegible]. Because of the [illegible] vessel [illegible] and pitched violently. In the vicinity [illegible] 1[illegible]°, 1[illegible]° [illegible], the direction of the current was [illegible] further south at [illegible], [illegible] the current [illegible] a velocity of [illegible] knots. At [illegible] the current [illegible] with velocity of 3.0 knots. Still further south at [illegible] 1[illegible]° [illegible], that is in the vicinity of Tok[illegible] I., the current [illegible] with a velocity of 1.6 knots. From the [illegible] it is clear that this current is [illegible] by the [illegible] south, Tokara I., however, [illegible] current [illegible] was

perceived while [illegible] lead to the conclusion that this area corresponds to [illegible] Equatorial Countercurrent and the southern Equatorial Current. Further south at the northern end of Djailolo Passage [illegible] N. 129° 30'E, the current was NxW with a velocity of 0.5 knots. This area appears to be where the tip of the southern Equatorial Current [illegible] flows west along northern New Guinea strikes the islands of Halmahera and Morotai and turns northward.

After we passed through Djailolo Passage on July 3 the wind shifted to the south but [illegible] force did not decrease, remaining at 5 to 6, and the seas were [illegible]. Thereafter until we passed Ceram I, the wind frequently [illegible] to southwest or south, but after we passed Ceram and entered the Banda Sea until we arrived at Timor the wind blew steadily from the southeast with forces of 4 to 5. This was the so-called easterly [illegible] of the Banda Sea, a seasonal wind which continues until August [illegible]. It is said that the strength of this wind gradually declines in September and October.

The [illegible] of the sea water everywhere between Tobalai I. and the west [illegible] was a dark cobalt color as contrasted with that of the waters of the South Banda Sea. Even beyond Ceram in the Banda Sea the water color appeared generally to be unfavorable, however, farther south near Timor where the first station was fished off Wetar I, the water color seemed rather good. Observations made during the first fishing trial showed a [illegible] at 40 meters.

The [illegible] changes in water temperature at that position were 27.9° at the surface, 27.4° at 25 meters, 27.2° at 50 meters, 23.4° at 100 meters, [illegible]° at [illegible] meters, 14.1° at 201 meters.

On July 8 the vessel sailed from Dilli in Timor I., proceeded east around the northern tip, rounded the eastern tip of the island, and [illegible] the Timor Sea. At this time the wind was from the northeast and [illegible] ranged [illegible]. The air temperature [illegible] 28.5° and as a result we felt quite cold.

While [illegible] at Dilli we made inquiries concerning the weather there and found that generally May, June, July, and August are the dry season while January to February are the rainy season, the two seasons thus being [illegible] to those of the Inner South Seas. During the so-called "Monsoon" season, which is the dry season, dry cool winds blow and although it is in the tropics one feels cool and refreshed. During the day in the Dilli region the seasonal wind begins to blow around 10:00 a.m. increases around 3:00 p.m., the morning and evening being usually completely windless. During the rainy season the wind blows from the northwest.

Observations taken at the second fishing station in the Timor Sea showed a [illegible] of 27 meters. The sea water seemed somewhat turbid compared [illegible] station and the vertical changes in water temperature were [illegible] the surface, 26.8° at 25 meters, 26.7° at 50 meters, [illegible] at [illegible] meters, 13.2° at [illegible] meters, and 10.2° at 300 meters.

The p[illegible] in the thir[illegible] we [illegible] of Tab[illegible], in the [illegible] part of th[illegible] [illegible] flowed south[illegible] and a low velo[illegible] to be [illegible]. It is thought that the current which flows west in the northern part of the Arafura Sea strikes Banither [illegible] coast. The transparency was [illegible] metres in the morning. Sea water temperature were 26.2° at the surface, 26° at 5 metres, 25.6° at 10 metres, 19.6° at 100 metres, 19.6° at 150 metres, and 19.6° at 200 metres. The temperature at the bottom level was lower than that in the [illegible]. This was the only [illegible] in the [illegible] [illegible] around the island. In the eastern part of that bay, or within [illegible] these operations in the open sea we encountered the southeast monsoon. To be more exact, the wind was from the [illegible] and it blew steadily with force generally from 4 to 5. The air temperature was around [illegible] degrees and those of us who were accustomed to the heat of the Inner South Seas could feel the coolness soaking into our bodies. To summarize the results of the oceanographic observations [illegible] in the eastern part of the Banda [illegible] the [illegible] temperature, salinity, [illegible] and water [illegible] [illegible] it was found that the water mass was generally more favorable in the eastern than in the western part. As for the vertical changes in water temperature, whereas in the Inner South Seas the difference between the surface and the 50-meter level is only [illegible] in this area it is 10° - 20°. The [illegible] at the 100-meter level had a minimum of 19.5° and a maximum [illegible], 1.5° lower than the 21.5° of the waters of our South Sea islands. After completing fishing tests in four places in the Banda Sea we made our last stop at the eastern end of [illegible]. What we noted of oceanographic conditions is that the current was northwesterly with a velocity of 0.8 knots. In other respects the situation was the same as in the Banda Sea, with no [illegible] worthy of special note.

On July 21 we traversed Dampier Strait and set a course for Palau. I will conclude with some remarks on the currents and oceanographic conditions which were observed along the way.

[illegible] at the noon position of 1° 51 N, 131° 10'E the current flowed [illegible] at the low velocity of 0.5 knot. It is thought that this area may be the northern limit of the southern equatorial current. The water [illegible] notably from this area on, and while steaming we caught one [illegible] yellowfin [illegible] on a trolling line.

On July 23 at the noon position of 4° 17'N, 133° 48'E the current flowed [illegible] at a velocity of 1.35 knots, indicating that we were in the equatorial countercurrent. On the following day, the 24th, at the noon position of 5° 1' N, 134° 1' E the current was SSE with a velocity of [illegible] knots, in which we could see the northward movement of the equatorial countercurrent.

[illegible]

First [illegible]

Morning and evening are, [illegible] considered the most suitable times for conducting experimental fishing [illegible] tuna with longlines, however, because the vessel was scheduled [illegible] port in Dili in Timor, a start was made on the preceding day, June 6, at 1530 about 8 miles off the west side of Ketar I. using 75 baskets of line set in a westerly direction.

From the time the vessel passed Leran I. and entered the Banda Sea the color of the sea water had generally appeared unfavorable, but as we moved gradually south into the vicinity of Ketar I. it improved. Observations on the station showed a transparency of 40 meters, and flocks of birds were seen flying in the vicinity. Although good tuna fishing was anticipated, only a yellowfin, a [illegible] marlin, and a skipjack were taken and the catch rate was less than [illegible] per 100 hooks, some of the fish were shark-bitten. It was felt that the transparency of the water was too great.

[illegible]

[illegible] we rounded the eastern tip of Timor and entered the Savu Sea. The second station was fished about 50 miles off shore. At 0600 June [illegible] 75 baskets were set in a NE direction. The bait, as in the previous trial, was a mixture of frozen saury and salted sardine which we had brought from Japan. Three hours and 40 minutes were required to set the 75 baskets of line. We began patrolling the line immediately after it was set, and we saw numerous schools of skipjack while [illegible]. These skipjack appeared to be small fish of about 2 kg (5.5 pounds) weight. While patrolling the lines, we took in one marlin (black) of about 40 kg, one yellowfin, and one blue shark.

We began hauling in the lines at [illegible]. Because the weight of the fish on the lines was too great for the buoyancy of the floats, the gear sank and the lines broke four times while we were hauling these. As a result, [illegible] required to haul in the 100 baskets of gear, and the work was not finished until 0230 the following day, July 10. The catch was 18 yellowfin, 10 albacore, 3 big-eyed, 1 white marlin, 2 black marlin, and 16 sharks, and 13 fish (10 yellowfin, 1 marlin) were damaged by shark-bite. The catch rate at this location, if the shark-bitten fish are not counted, was 3.8, and with the shark-bitten fish it was 4.9. Furthermore, because of the difficulty of getting materials, the gear used in this test was made with rather fine line and wire in some of the branch lines, and for this reason 50 of the branch lines or hooks were broken off the gear by the fish. If these were added in to the total, the catch rate would be considerably increased.

Dairen Trial

The [illegible] of this fishing ground was 8° 53'S, 1 9° 55'E, south-

west of Tanimbar I. On July 11 at 0505 120 baskets of gear were set in an ESE direction. It required 3 hours and 10 minutes to set the lines, and the total length of the lines was 10.5 miles. While patrolling the lines we hooked 5 yellowfin and 1 big-eyed. Eight hours were spent in hauling the lines, and the total catch was 14 yellowfin, 2 big-eyed, 1 albacore, and 1 broadbill; 47 fish were damaged by sharks and killer whales. Most of the yellowfin taken were large ones over 130 cm in length. The catch rate was 2.5 without the shark-bitten fish, or 9.0 including them.

In addition 31 hooks were broken off the lines so, if this is taken into consideration, the catch rate should be further increased in view of the amount of fish occurring in the area. A peculiar phenomena which should be noted in connection with this trial is the fact that, aside from the fish damaged by sharks, there were 40 fish eaten by killer whales. The remains of fish eaten by killers differ from those damaged by sharks. In the case of the killers only the head of a hooked tuna is left, and the distinction is clear at a glance.

Fourth Trial

The position of this fishing ground was 7° 05'S, 130° 30'E, to the west of Tanimbar I. On July 12 at noon 120 baskets were set in an ESE direction. About eight hours were required for setting the lines, and the catch was 80 yellowfin, 1 true marlin, 1 sailfish, 1 big-eyed, and 4 sharks, with 18 fish damaged by sharks. In addition 17 hooks were broken off the lines. The catch rate was 11.5 without the shark-bitten fish, or 14.0 with them. Measurements of the yellowfin taken showed that the greatest number fell within the range of 130 cm long (assumed to be fish in their ninth year). The big-eyed tuna was about 153 cm long. When the yellowfin were gutted, the gonads were examined, but all of them were found to be immature with no distinguishable ova.

Fifth Trial

The position of the fishing ground was 6° 58'S, 130° 38'E, off the west side of Tanimbar I. On July 13 at 0600 we set 185 baskets of line in a NW direction. The excessive weight of the fish on the lines sank the gear and it could not be hauled in with the line-hauler. The attempt was made to haul it by manpower, but in the end the lines parted and 50 baskets of gear was unavoidably lost. A long time was required to haul the lines in, the operation beginning at 1150 and being completed at 2350. It actually took 12 hours.

The catch was 52 yellowfin, 1 big-eyed, 1 black marlin, 1 true marlin, and 5 sharks, with 10 more fish shark-damaged and 10 hooks torn off the line. The catch rate was 6.8 without the shark-bitten fish, and 8.0 if they are included. Since it can be presumed that there were many tuna hooked on the 50 baskets which were lost, the catch rate should be considered even higher.

[illegible] bark and [illegible] er, hagfish

Set 1

[illegible] the fishing [illegible] 5° 4.5', 1.5° 1' E, off [illegible]. On July 1 a [illegible] baskets of gear were [illegible] for a [illegible] .5 miles. Fishing [illegible] the [illegible] at 1122 [illegible] at 1141. During the [illegible] [illegible] of line [illegible] the line did not break and we [illegible] the [illegible] this [illegible] [illegible] was [illegible] yellowfin, 1 big-eye, and [illegible] hooks were left [illegible] [illegible] and nine branch lines [illegible].

The catch rate was 13.3 not counting the shark-bitten fish, or [illegible] these are included. Length-weight relationships showed that the smallest was just under 1 meter and most of them were [illegible] = 120 cm in length. An examination of the stomach contents made [illegible] gutting the fish showed that they had been eating mostly squid.

Set 2

The gear was set this day [illegible] at 5° 1.5', 131° 1.5' W, [illegible] [illegible] at 1410 but backing was not [illegible] NNE direction. In order to prevent the weight of the hooked fish from sinking the gear we began this day on to attach two glass floats and two styrofoam wood floats to each of the four lines. While patrolling the lines we sighted 7 yellowfin.

The catch was 47 [illegible] with [illegible], 1 [illegible], 1 [illegible] marlin, and [illegible] [illegible] shark-bitten, [illegible] and 3 broken branch lines. The catch rate was 6.7 if the shark-bitten fish are accepted, or 10.0 if they are included.

Set 3

The [illegible] of the fishing ground was 4° 4.5' [illegible] 131° 31'W, east [illegible] July 17 at 0810 [illegible] baskets were set in a west [illegible] [illegible] the water color was good on the fishing ground, [illegible] [illegible] while patrolling the line we hauled in 4 yellowfin and 1 [illegible] shark. The total catch was 4 yellowfin, 11 big-eye, [illegible] in addition to which there were 21 shark-[illegible] [illegible] branch lines. The catch rate was 1.4 without the [illegible] [illegible] if these are included. The yellowfin in the [illegible] [illegible] [illegible] m long.

Set 4

[illegible] fishing ground was 4° 27.5', 130° 22.5' W, [illegible] July 19 at 1[illegible]. Five baskets of gear were set in [illegible] [illegible] on the fishing ground the water temperature at the [illegible] [illegible] and the water color was good, although [illegible] [illegible] with a transparency of 15.5.

While [illegible] the lines we hauled in 11 yellowfin and 1

shark-bitten yellowfin. The total catch was 116 yellowfin, 6 big-eyed, and 17 sharks, an average of 10 fish to which there were 38 shark-damaged fish and 17 broken lines. Four hours were required for hauling in the lines, and the catch rate was 15 fish without the shark-bitten fish, or 20,5 if these are included. This was the highest rate obtained in these tests. There was also a particularly large amount of shark damage at this position, being in this respect second only to the ground fished in Trial 5.

Tenth Trial

The position of this fishing ground was 3° 35'S, 131° 54'E, east of Teram I. After six trials in the Banda Sea the expedition had completed its fishing operations and was heading back to its base, but the lines were set just as an experiment and nothing much was expected from the grounds. On July 12 at 1640 40 baskets were set in a NW direction.

The water color on the fishing ground was bad, with a transparency of 11 meters. The catch was 4 yellowfin, 1 sharks, and shark-bitten fish. The catch rate was 4.3 excluding the damaged fish, or 5.0 if these are included.

4 Conclusion

This investigation was carried out in three sea areas: the Timor Sea, the Arafura Sea, and the Banda Sea. However, the number of fishing trials made in the Timor and Arafura Seas was small and it is feared that the data are insufficient for evaluating those fishing grounds. The single trial established in the former showed a catch rate of 3,9 while the latter had a rate of 8,0, showing that in general it can be considered to have a certain value as a fishing ground.

In the results of six trials in the Banda Sea the catch rates ranged from a minimum of 8,0 to a maximum of 20,5, these high rates indicating that tunas occur there in considerable abundance. Among the tunas yellowfin were most numerous followed by big-eyed, and marlin were plentiful. Albacore occurred in the least abundance, just as in the waters of our South Sea Islands. The yellowfin were generally large fish, many of them being over 130 cm long. An examination of the gonads of the yellowfin revealed that during the period covered by these investigations they are almost completely unripened.

From a consideration of the relationship between oceanographic conditions and the fishing situation it appears that the water temperatures at the 100-meter level are far lower than in the Islands and that 12° to 20° are suitable temperatures.

Sharks occur in remarkable abundance in the eastern part of the Banda Sea, and the investigations revealed that shark damage to hooked fish is great. The rate of such damage ran from 13% to 73% with an average of 27%. This high rate of shark damage is ample evidence of the undeveloped character of these grounds and it is expected that such

damage will decrease in the future as tuna boats penetrate into and develop these grounds.

During the course of these investigations the author has felt deeply that, when the time comes that we can freely establish fishing bases in areas under foreign control, the tuna resources of these foreign waters have a boundless future.

The Banda Sea is within four or five days' sailing for vessels based on Palau, and for vessels coming from Japan Proper the trip one way would require ten days. This is less than half the time required for vessels fishing in the waters of our South Sea Islands. It is hoped that commercial operators will increasingly make this area their objective for fishing and development.

Relationship Between Catch Rate, Water Temperature, and Transparency

Number	Station	Catch Rate*	Temperature at 100m	Transparency
			°C	Meters
1	9	20.5	19.0	25.5
2	6	16.0	20.1	22.0
3	4	14.0	20.0	26.0
4	8	10.3	18.8	26.0
5	7	10.0	19.9	24.0
6	3	9.0	19.8	27.0
7	5	8.0	21.5	37.0
8	10	5.0	20.4	11.0
9	2	3.9	23.4	27.0
10	1	2.0	23.4	27.0

* fish per 100 hooks

From the above data it appears that temperatures of 18-20° at the 100-meter level are favorable for fishing, and in general a tendency can be seen for the fishing to become poorer when the temperature rises above 23°. Optimum transparencies appear to be between 23 and 27 meters, while clear water with transparencies greater than 30 meters and turbid (unclear) water with transparencies less than 10 meters are unfavorable for fishing.

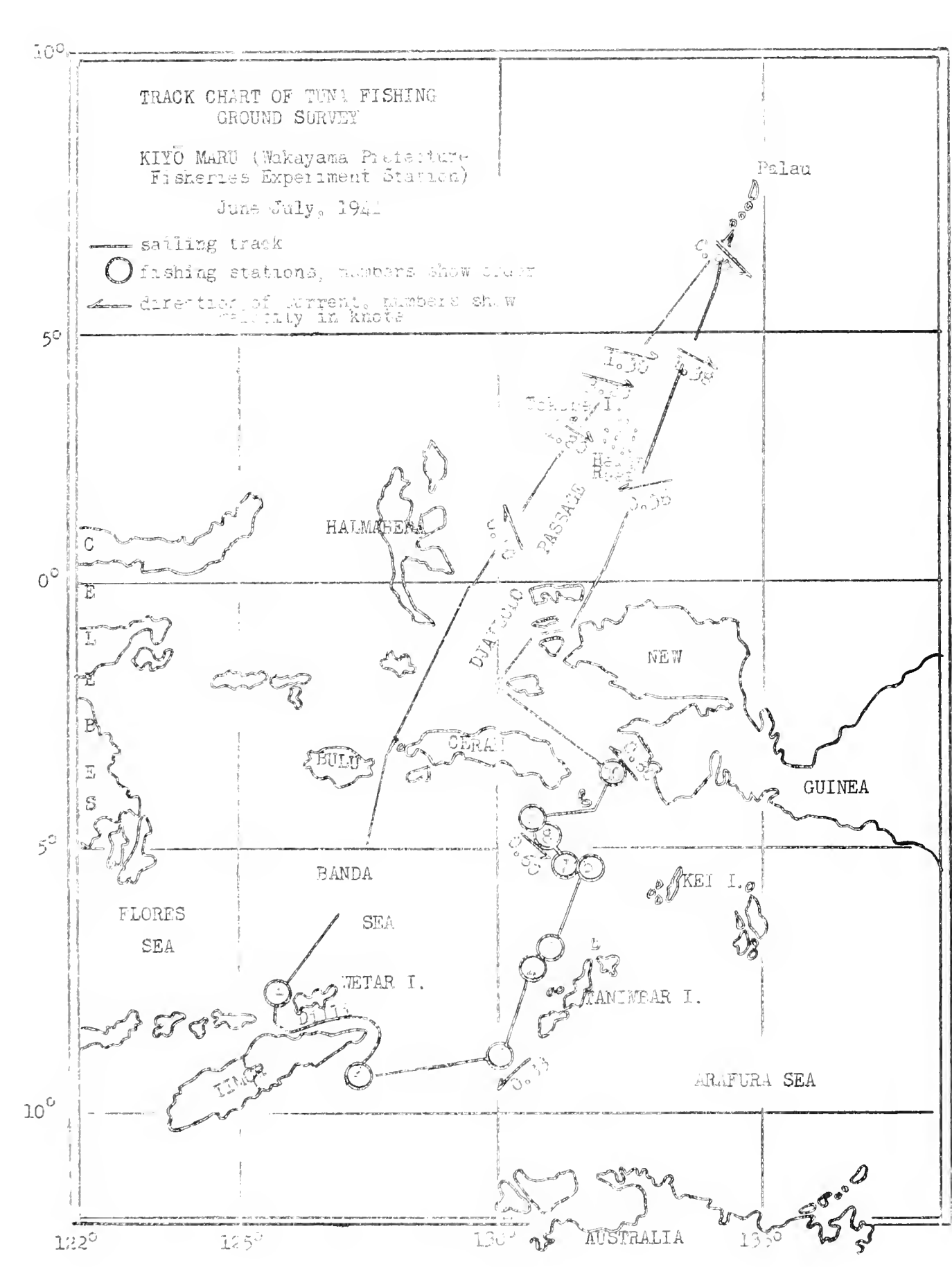
Table of Fishing Trials

Trial No.	Date	Amount of Gear	Setting Gear		Hauling Gear		Catch	Catch Rate *	Catch Rate **
			Began	Finished	Began	Finished			
1	7-[illegible]	50(baskets)	1530	1630	2005	2037	4 yf, 1 bm, 1 b-e, 1 sk	2.0	0.0
2	7-9	200	0501	0845	1505	0227	18 yf, 10 alb., 1 b-e 2 bm, 1 wm, 13 s-b	3.9	2.3
3	7-11	120	0505	0716	1328	2015	24 yf, 2 b-e, 1 alb.	2.0	1.7
4	7-12	125	0007	1430	1725	0106	1 bb, 47 sb, 30 yf. 1 bm, 1 sf, 1 b-e, 19 sb, 1 sk.	1.4	0.5
	7-13	18[illegible]	06[illegible]	1030	[illegible]	2350	33 yf, 1 b-e, 1 bm, 1 wm, 10 sb	2.0	1.3
6	7-15	100	0540	0724	1[illegible]	1[illegible]	38 yf, 2 b-e, 15 sb	15.0	13.3
7	7-16	100	0510	0715	1334	1720	47 yf, 43 b-e, 2 wm, 21 sb	10.0	10.0
8	7-17	120	0515	0750	1125	1235	42 yf, 13 b-e, 21 sb	10.3	7.4
9	7-18	130	0520	0203	1225	2020	116 yf, 6 b-e, 32 sb	20.5	19.5
10	7-19	20	1645	1712	1840	1945	4 yf, 2 sb	5.0	3.3

* Catch rate including shark-bitten fish. ** Catch rate excluding shark-bitten fish.

yf ... yellowfin b-e ... big-eyed bm ... black marlin tm ... true marlin wm ... white marlin
sf ... sailfish bb ... broadbill alb .. albacore sb ... shark-bitten sk ... skipjack

(Note) The amount of gear for No. 5 is 185 baskets, but 50 of these baskets were lost so the amount of gear hauled in was 135 baskets. The catch rate is calculated for 135 baskets.


TRACK CHART OF TUNA FISHING GROUND SURVEY
KIYŌ MARU (Wakayama Prefecture Fisheries Experiment Station)
June-July, 1941
sailing track
fishing stations, numbers show order
direction of current, numbers show velocity in knots
Palau
HALMAHERA
PASSAGE
NEW GUINEA
BULU
CERAM
BANDA SEA
FLORES SEA
KEI I.
ARAFURA SEA
AUSTRALIA
10°
5°
0°
5°
10°
122°
125°
130°
135°